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USSR Report

SPACE

No. 10



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MANNED MISSION HIGHLIGHTS

CHRONOLOGY OF 'SOYUZ T-4' MISSION

[Editorial Report] The Soviet News Agency TASS reports the following information on activities connected with the flight of "Soyuz T-4":

12 March

At 2200 hours Moscow time the "Soyuz T-4" spacecraft was launched with a crew consisting of Flight Commander Colonel Vladimir Kovalenok and Flight Engineer Viktor Savinykh. The flight program includes docking with the "Salyut-6"--"Progress-12" complex and performance of repair and maintenance operations and scientific research. [Moscow TASS in English 2029 GMT 12 Mar 81]

13 March

The "Soyuz T-4" cosmonauts are preparing for docking. A trajectory correction was carried out during the fourth revolution. Orbital parameters of "Soyuz T-4" are now: apogee, 331 km; perigee, 250 km; period of revolution, 90.1 min; orbital inclination, 51.6 degrees. [Moscow TASS in English 1112 GMT 13 Mar 81]

14 March

At 2333 hours Moscow time the "Soyuz T-4" docked with the "Salyut-6"--"Progress-12" complex and the crew transferred to the "Salyut-6" station. The cosmonauts will begin checking the station's equipment and will unload the "Progress-12" cargo ship. Their scientific work program includes earth resources studies, astrophysical research and technical and biomedical studies. [Moscow TASS in English 0022 GMT 14 Mar 81]

15 March

The cosmonauts' second working day began at 0800 hours and will continue until 2300 hours Moscow time. The crew is reactivating the station systems for power supply, thermal regulation and gas composition. Yesterday the "Progress-12" hatch was opened and the cosmonauts began transferring supplies. They also prepared for

operation the "Rodnik" system which pumps water from "Progress-12" into the station's tanks. Biological experiments have been started. The cosmonauts planted seeds of Arabidopsis in the "Fiton" unit and are preparing the "Malakhit" space greenhouse for operation. Both cosmonauts' adaptation to weightlessness is proceeding normally. [Moscow TASS in English 1209 GMT 15 Mar 81]

16 March

During the cosmonauts' third working day they will continue to activate "Salyut-6" systems and unload the "Progress-12". The cosmonauts will perform the "Anketa" experiment to study symptoms of vestibular disturbance in conditions of weightlessness. They will also evaluate the condition of their muscular systems and will make the first measurements of their body mass. In the evening a trajectory correction will be performed using the "Progress-12" propulsion unit. Microclimate parameters in the working compartments are: temperature, 20 degrees C; pressure, 800 mm Hg. [Moscow TASS in English 1112 GMT 16 Mar 81]

18 March

The cosmonauts have completed reactivation of "Salyut-6" systems and have finished unloading "Progress-12". Yesterday the cosmonauts installed a new unit in the solar battery orientation system and replaced a pump for removal of condensation in the thermoregulation system. Today the cosmonauts, guided by recommendations of specialists, are checking electrical circuits in the station's control system and making necessary repairs using a set of tools brought in the "Soyuz T-4". The crew is also exercising on the veloergometer and monitoring the biological experiments. The process of adaptation to weightlessness has practically been completed. [Moscow TASS in English 1118 GMT 18 Mar 81]
[88-P]

CSO: 1866

UDC 629.197

MECHANICS OF AN ORBITAL TETHER SYSTEM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 678-688
manuscript received 17 Sep 79

BELETSKIY, V. V. and LEVIN, Ye. M.

[Abstract] An orbital tether system consists of a carrier-satellite and a satellite-probe attached to the carrier by a long tether. Gravitational and aerodynamic forces act on such a system, as well as the force generated by the satellite's attitude-correction unit. Such systems are of interest for studying the middle atmosphere (at altitudes of 80-180 km)--for which no other method is suitable--by means of probes suspended from a satellite by means of a long (up to 100 km) tether. The authors derive the equations of motion and relative equilibrium for a satellite-tether-probe system and determine the equilibrium configurations of an infinite tether in a gravitational field where there is also atmospheric resistance. They also discuss special cases and compensating thrust for the tether's mass. They use as an example a probe weighing 100 kg, with a cross-sectional area of 1 m^2 , that is suspended by a steel cable from a carrier-satellite weighing 10 t. The mass of such a cable that is about 1 mm thick is only about 100 kg when it is about 100 km long, which requires a constant compensating engine thrust of only about 1 kg. Figures 5; references 8: 6 Russian, 2 Western.

[46-11746]

UDC 531.38

OPTIMUM STABILIZATION OF AN UNSYMMETRICAL SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 689-697
manuscript received 19 Jun 79

AKULENKO, L. D.

[Abstract] In studying the controlled revolution of a solid in a correlated coordinate system, there are two problems: that of undisturbed motion and that of disturbed. The latter applies to the orbital motion of an unsymmetrical satellite. The author first discusses the undisturbed problem and uses it as a basis for working with the disturbed variant. He finally formulates an algorithm for the approximate solution of the disturbed problem for the optimally fast braking of an unsymmetrical satellite and then uses it in several specific examples. References 13.

[46-11746]

OPTIMUM CONTROL OF THE ELLIPTICAL ORBIT OF A SATELLITE WITH A LOW-THRUST ENGINE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 707-714 manuscript received 14 Jan 80

VASIL'YEV, V. V.

[Abstract] The low-thrust electrojet engines that are used for satellite course corrections exert a control effect that is comparable to that of atmospheric resistance and the disturbing accelerations caused by the eccentricity of the Earth's gravitational field, and this fact must be taken into consideration when formulating a satellite motion control algorithm. The author formulates optimum programs for the plane correction of elliptical orbits of spacecraft with low-thrust electrojet engines, with due consideration for the eccentricity of the gravitational field and atmospheric resistance. He also states that an analysis of these programs can be used as the basis for formulating basic motion-control rules that are close to optimum. Figures 5; references 10: 9 Russian, 1 Western. [46-11746]

EFFECT OF DIFFERENT APPROXIMATIONS OF THE GEOMAGNETIC FIELD ON THE ACCURACY OF THE PARAMETERS OF MODELS OF AN ARTIFICIAL EARTH SATELLITE'S REVOLUTION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 715-721 manuscript received 23 Apr 79

ZABLUDA, S. M. and YANSHIN, A. M.

[Abstract] The authors determine, in the most general case, all the parameters of the Earth's magnetic field that appear explicitly in the equations for the revolutionary motion of an artificial Earth satellite and investigate the behavior of these parameters as a function of the number of multipoles allowed for in the international analytical field, for a whole series of osculating elements in satellite orbits. They set up a model of the geomagnetic field and a system of coordinates, then apply them to the librational and rotational motion of satellites, and evaluate the errors in the absolute value of the Earth's magnetic field's intensity for different approximations of the international analytical field. Their conclusion is that for any specific satellite, their method makes it possible to select an orbit and determine the areas in that orbit where the magnetic disturbances do not exceed a given value. Figures 5; references 7. [46-11746]

METHODS FOR DETERMINING NAVIGATION FUNCTIONS ON THE BASIS OF AMBIGUOUS MEASUREMENTS OF THE COORDINATE PARAMETERS OF MOTION OF SPACECRAFT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 722-732
manuscript received 21 May 79

CHAPLINSKIY, V. S. and NEVOL'KO, M. P.

[Abstract] The authors formulate the problem of evaluating the navigation function of spacecraft on the basis of ambiguous measurements, then use the Bayes criterion for evaluating the parameters of a random function to find a general solution for it. They also use the method of equidistant cross-sections and the vernier method to determine the most probable estimate of the vector of state of the coordinate navigation functions and conclude that the former method yields better results when ambiguous measurements are used, but that when the initial information is more accurate, the method of successive refinement of the estimates with respect to the measurement scales works better. References 3.

[46-11746]

INVESTIGATION OF THE VARIATIONS IN O^+ AND N^+ ION CONCENTRATIONS, THE DYNAMICS OF THE IONOSPHERE AND FLOWS OF ACTIVE ELECTRONS IN THE OUTER IONOSPHERE FROM THE 'METEOR' SATELLITE: 2. MEASUREMENTS IN THE EQUATORIAL IONOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 733-739 manuscript received 20 Apr 79

IVANOV, G. V., PERKOV, I. A., POGULAYEVSKIY, L. I., ROMANOVSKIY, Yu. A., RYLOV, Yu. P. and YAICHNIKOV, A. P.

[Abstract] The "Meteor" satellite was used to measure the composition of the outer ionosphere, at an altitude of about 900 km, from June 1976 to February 1977, which was a period of minimum solar activity. The amplitude of the daily variation in the concentrations of O^+ and N^+ ions was small, but there was a clearly expressed, quasiperiodic irregularity in their distribution near the equator. On the basis of a study of the changing N^+/O^+ ratio, the authors conclude that the $O^+ + H = H^+ + O$ reaction is an effective source of O^+ ions when there is a small discharge of them because of transfer processes. Figures 3; references 24:

⁴ Russian, 20 Western.

[46-11746]

INVESTIGATION OF THE SUN'S SPORADIC RADIO-FREQUENCY EMISSIONS AND THE PARAMETERS OF THE EARTH'S IONOSPHERE FROM THE 'INTERCOSMOS-KOPERNIK 500' SATELLITE: 5. RESULTS OF INVESTIGATIONS OF THE ELECTRON CONCENTRATION IN THE IONOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 740-747
manuscript received 2 Apr 79

AKSENOV, V. I., ARTEM'YEVA, G. M., KOMRAKOV, G. P., SKREBKOVA, L. A. and KHANASH, Ya.

[abstract] The "Intercosmos-Kopernik 500" satellite was used to measure the ion concentration at altitudes of 200-1,500 km in all longitudinal zones. The measurements were made over a 6-month period in 1973, and covered the area between 50° N. Lat. and 50° S. Lat. The authors divide their study of the electron concentration into two periods--magnetically quiet and magnetically disturbed--and determine that there are no significant variations between the two. They also plot temporal and geographic variations in the electron concentration. Figures 5; references 7: 3 Russian, 4 Western.
[46-11746]

PHOTOCHEMISTRY OF THE LOWER F-LAYER AND STRUCTURAL PARAMETERS OF THE IONOSPHERE, AS DETERMINED FROM INTEGRATED TERRESTRIAL AND ROCKET EXPERIMENTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80
pp 748-753 manuscript received 15 Jun 79

BIRYUKOV, A. V., DANILKIN, N. P., DENISENKO, P. F., KUCHERENKO, G. M., KNORIN, I. A., RODIONOVA, V. T., RUDAKOV, V. A., SOTSKIY, V. V., FAYER, Yu. N., SHNYREVA, L. A. and SHYUTTE, N. M.

[Abstract] Rockets in the "Vertikal" series were used to obtain altitudinal profiles of the neutral composition (O , O_2 , N_2), electron concentration and effective frequency of electron collisions. The launch dates were 2 September 1975 and 14 October 1976. Measurements were made at altitudes of from less than 100 km to about 1,300 km, with special emphasis on the band between 100 and 250 km. The authors present the results and discuss them as they apply to the photochemical model of activity below the maximum height of the F-layer. Figures 5; references 31: 9 Russian, 22 Western.
[46-11746]

OBSERVATIONS OF HEAVY IONS IN THE SOLAR WIND ACCORDING TO DATA FROM THE 'PROGNOZ-7' SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 761-765
manuscript received 4 Dec 79

VAYSBERG, O. L., YERMOLAYEV, YU. N., ZASTENKER, G. N. and OMEL'CHENKO, A. N.

[Abstract] An electrostatic ion analyzer in an SKS plasma spectrometer was used to measure the solar wind's heavy ion content on board the "Prognoz-7" satellite from 1800 h, 10 December, to 0600 h, 13 December 1978. The wind's parameters during this period were: velocity--280-330 km/s; ion concentration-- $\sim 8-40 \text{ cm}^{-3}$; proton temperature-- $\sim 2 \cdot 10^4 - \sim 5 \cdot 10^4 \text{ K}$; α -particle temperature--the same or lower. The authors compare the results of the measurements with other available data and find that the period in question is distinguished by a high concentration of heavy ions (silicon, iron, oxygen), but state that their analysis of the data is incomplete and that further study is needed. Figures 4; references 9: 1 Russian, 8 Western.
[46-11746]

RELATIVISTIC PROTONS IN THE SOLAR FLARE OF 24 SEPTEMBER 1977

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 801-804
manuscript received 21 Jun 79

BLYUDOV, V. A., VOLODICHEV, N. N., KOLESOV, G. Ya., NECHAYEV, O. Yu.,
PODOROL'SKIY, A. N., SAVENKO, I. A. and SUSLOV, A. A.

[Abstract] Solar proton flares containing protons with energy levels of 500 MeV and higher are rare: of the more than 1,700 flares observed in 1977, there were only 5 of them. One of these occurred on 24 September 1977 and was registered by instruments on board the "Prognoz-6" automatic orbital station (apogee--197,900 km; perigee--498 km, period of revolution--94 h, 48 min, orbital inclination-- 65°). The flare apparently occurred on the far side of the Sun. Although the mechanism of the acceleration of protons to energy levels above 500 MeV is still not clear, the authors conclude that their findings support Lin's hypothesis that there may be two acceleration processes in large flares: 1) electrons are accelerated to energy levels of several tens of kiloelectronvolts and (possibly) protons to several hundred kiloelectronvolts; 2) electrons and protons with energy levels all the way up to relativistic are generated. Figures 3; references 15: 11 Russian, 4 Western.
[46-11746]

INTERPLANETARY SCIENCES

USSR ASTRONOMICAL INSTITUTES AND OBSERVATORIES

Moscow ZEMLYA I VSELENNAYA in Russian No 1, 1981 pp 52-62

/Articles by A.A. Nemiro, doctor of physical and mathematical sciences, and K.N. Tavastsherna, candidate of physical and mathematical sciences; B.Ye. Zhilyayev and A.G. Totochava, candidates of physical and mathematical sciences; G.M. Tovmasyan, doctor of physical and mathematical sciences, deputy director, Byurakan Astrophysical Observatory, Armenian SSR Academy of Sciences; Ye.K. Kharadze, corresponding member, USSR Academy of Sciences, director, Abastumani Astrophysical Observatory, Georgian SSR Academy of Sciences; L.S. Lood, candidate of physical and mathematical sciences, deputy director, Institute of Astrophysics and Atmospheric Physics, Estonian SSR Academy of Sciences; V.G. Teyfel', candidate of physical and mathematical sciences; A.G. Gorshkov, candidate of physical and mathematical sciences; V.V. Kasinskiy and V.M. Tomozov, candidates of physical and mathematical sciences, and V.S. Bashkirtsev and G.P. Mashnich⁷

/Text/ In 1976 -- the year of the 25th CPSU Congress -- the largest 6-meter telescope in the world went into operation at the USSR Academy of Sciences' Special Astrophysical Observatory. In 1977, observations began to be made with another perfected astronomical instrument, the RATAN-600 radiotelescope. Using these unique instruments, astronomers obtained extremely interesting scientific information (ZEMLYA I VSELENNAYA, No 6, 1977, pp 40-48; No 6, 1979, pp 4-9; No 5, 1980, pp 31-35). The quality and quantity of the equipment at many other observatories was also improved. The skillful combination of new observation techniques (space techniques, in particular) and traditional methods of astronomy has enabled Soviet astronomers to achieve great effectiveness in their research and to make a weighty contribution to the development of the applied and fundamental sciences.

Main Astronomical Observatory, USSR Academy of Sciences: Compilation of Star Catalogs for the Entire Sky Has Been Completed

The Pulkovo Observatory -- one of the oldest scientific institutions in our country -- observed its 140th birthday in 1979.

From its very first days, the observatory was widely recognized for its outstanding work in the field of fundamental astronomy. At the present time this work still occupies a leading place in its diversified research. One of the most northerly

observatories in the world (at a latitude of almost 60°), the Pulkovo Observatory cannot, because of its location, observe heavenly bodies in the skies of the Southern Hemisphere. Nevertheless, observations of the southern stars are particularly necessary at the present time because their coordinates and proper motion are known with much less accuracy than those of the northern stars. This is because there is actually only one actively operating astrometric observatory in the Earth's Southern Hemisphere, and it is not capable of competing in work volume and accuracy with the more than 10 such observatories in the Northern Hemisphere. This is why in the early 1960's, on the initiative and with the basic participation of Corresponding Member N.S. Zverev of the USSR Academy of Sciences, a southern astrometric expedition was organized (ZENLYA I VSELENNAYA, No 2, 1973, pp 16-23). The expedition, using both local instruments and new ones that were produced especially for it, made more than 250,000 highly accurate astrometric observations of stars in the southern sky during its 10 years of existence.

After combining the observations of the stars in the southern sky with the 250,000 observations of stars in the northern sky that were made at Pulkovo in the 1950's, for the first time in the history of Russian astronomy we became the possessors of a unique set of astrometric material amounting to more than half a million observations of stars distributed throughout the entire sky, from the North Pole to the South Pole. This extensive volume of observation material needed careful processing, reduction to a unified system, and thorough analysis.

Having first processed the observations of the northern stars, for the last 5 years we have been processing and analyzing the observations of the stars in the southern sky. In connection with this and as a matter of international collaboration, to the mass of observations made by the Pulkovo astronomers we added those made according to a Pulkovo Observatory program in Melbourne from 1928 to 1941. These observations had remained unprocessed because the observatory in Melbourne ceased its scientific activity -- it became a museum in 1944.

The extensive and exceptionally important (in both the scientific and practical respects) work of the Pulkovo astrometric specialists, which has produced a more or less modern model of the pattern of stars in the sky, was completed in 1980. As a result we have obtained 20 star catalogs that record the highly accurate coordinates of about 30,000 stars, throughout the entire sky, for the modern era.

This valuable scientific material will be used for many decades in the most diversified astronomical investigations. It has already become an important component of the FK 5 international fundamental star catalog, which is used as the international standard in all astronomical and geodesic work requiring the highest accuracy.

The astrometric specialists at the Pulkovo Observatory consider the completion of these many years of work to be their modest contribution to the preparations being made by our entire nation for the meritorious convening of the 26th Congress of the Communist Party of the Soviet Union.

Main Astronomical Observatory, Ukrainian SSR Academy of Sciences, and Abastumani Astrophysical Observatory, Georgian SSR Academy of Sciences: Are Normal Stars Variable?

Cooperative investigations are being carried out at many Soviet observatories. On the basis of an agreement on creative collaboration, the Ukrainian SSR Academy of Sciences' Main Astronomical Observatory and the Georgian SSR Academy of Sciences' Abastumani Astrophysical Observatory have been studying the variability of normal stars.

As is known, main sequence stars do not have visible indications of variability in their brightness and have traditionally been regarded as stable. However, not long ago the authors reached the conclusion that most (i.e. not all) normal stars have variable brightness with amplitudes of thousandths of a stellar magnitude.

Practice has shown that even when photoelectric observations are made with large telescopes, it is difficult to achieve a level of accuracy in determining a star's brightness that is better than several tenths of a percent. Therefore, it is impossible to construct a brightness curve when studying microvariability. The detection of microvariability and the evaluation of its amplitudinal and frequency properties becomes possible with the help of special statistical methods for processing series of observations.

Six main sequence stars in spectral classes A2V-K1V were observed continuously for 2-3 hours. We used a photometer with a quantum counter, which unit was mounted on the 48-cm telescope at the Abastumani Astrophysical Observatory. In most cases the statistical spectral analysis of fluctuations in brightness indicated the presence of small-scale variability on the part of normal stars.

The variations in brightness are the sum of a series of harmonics with periods ranging from several minutes to hours, with amplitudes measured in thousandths of a stellar magnitude. These results were obtained with a statistical reliability of at least 95 percent. The microvariability is of an unstable nature. We only sometimes succeeded in observing individual harmonics, while others were seen steadily for many nights.

When investigating microvariability, it is important to allow for atmospheric transparency. In order to do this, we made quasisynchronous observations of two normal stars in spectral class A. A comparison of the spectra indicates that the stars' inherent microvariability is of a physical nature.

The authors think that the microvariability of normal stars is related to nonradial fluctuations. This mechanism apparently also explains the variability of stars of the δ -Scuti type (ZEMLYA I VSELENNAYA No 4, 1977, pp 27-28) and global variations in the velocity field on the Sun, which were discovered at the USSR Academy of Sciences' Crimean Astrophysical Observatory by a team under the leadership of Academician A.B. Severnyy (ZEMLYA I VSELENNAYA, No 6, 1977, pp 36-39). If this hypothesis is confirmed, the study of microvariability can become an effective means for investigating the internal structure of stars.

Byurakan Astrophysical Observatory, Armenian SSR Academy of Sciences: Observations With the 2.6-m Telescope

October 1976 saw the official unveiling of the Byurakan Observatory's largest telescope, a 2.6-m reflecting telescope manufactured by the Leningrad Opticomechanical Association. At this telescope's primary focus (field -- 47', focal length -- 10 m,

photograph scale -- 21.4 s/mm) it is possible to take direct photographs of heavenly objects. The telescope has three (Nesmit) foci (focal length -- 40 m, scale -- 5 s/mm) that are used for electrophotometric and spectral observations and a coude focus with a focal length of 100 m.

The telescope's dome was designed and manufactured at the Byurakan Opticomechanical Laboratory. It is 21 m in diameter and weighs 125 t. The dome is mounted on 24 rubber-covered rollers, four of which are connected to electric motors and rotate, causing the dome to revolve. Because of this design the dome turns smoothly and noiselessly.

During the first period of the telescope's operation, its primary focus was used most intensively. Direct photographs were used to investigate the structure of the galaxies with excessive ultraviolet radiation that were discovered at Byurakan and have been named Markaryan galaxies. The photographs that were obtained have made it possible to detect double and multiple nuclei in 15 Markaryan galaxies (ZENLYA I VSELENNAYA, No 5, 1980, pp 31-35). The distance between the nuclei's components is usually about 3" or a little more, although in galaxy Markaryan 325 it is about 1.5". The presence of double and multiple nuclei apparently indicates that in the central parts of these active galaxies there are taking place extremely violent processes that result in the division of their nuclei.

Striking variability in a single comet-shaped nebula (GHI-29) was discovered on photographs taken with the 2.6-m telescope when it was being aligned. Although on the maps in the "Palomar Atlas of the Heavens" we can see a very weak nebula with a bright star at its head and a rather bright jet stretched out in a direction away from the star, in the 1976 photograph the jet had almost disappeared and the nebula itself had become extremely bright. Later the jet became a little bit brighter and the nebula slightly dimmer, after which it again became brighter.

In the last 2-3 years, astronomers at Byurakan and Pulkovo have been using this telescope successfully to make infrared observations of stars with anomalous chemical compositions. In the observations we used more than 10 narrow-band filters in terrestrial atmosphere transparency windows from 1 to 2.5 μm .

Systematic observations of a large number of stars of certain types revealed some interesting statistical regularities. In particular, it was demonstrated that the magnitude of the infrared surplus that is frequently observed in carbon stars depends on an abundance of carbon in their atmospheres, and not on the surface temperature. This result raises doubts about the widely held hypothesis that dust particles in the atmospheric shells near stars are formed by condensation from gas. Also, there is no correlation between an infrared surplus and the temperature for stars with a high zirconium content. As far as their color characteristics are concerned, carbon stars differ noticeably from stars with a normal chemical composition, which makes it possible to distinguish carbon stars without a laborious spectral analysis of their chemical composition on the basis of infrared photometry alone. For red giants in spectral class M, we have found a correlation between the amount of water in their atmospheres and their spatiokinematic characteristics: the higher a star's radial velocity and the farther it is from the galactic plane, the more water there is in its atmosphere.

Abastumani Astrophysical Observatory, Georgian SSR Academy of Sciences: A Mass Spectral Classification of Stars

The Georgian SSR Academy of Sciences' Abastumani Astrophysical Observatory has completed an extensive project for the mass, two-dimensional spectral classification of relatively weak stars in the Kapteyn [translation unknown] Areas on the basis of moderate dispersion spectra.

The results of the work were published in two consecutive issues of the BYULLETEN' ABASTUMANSKOY OBSERVATORII [Bulletin of the Abastumani Observatory] (Nos 50 and 51) in 1980. In one of them, author R.A. Bartaya explains the techniques and interprets the statistical data and the conclusions of a stellar astronomy nature. The other issue contains the "Catalog of Spectral Classes and Classes of Luminosity of 10,396 Stars in the Kapteyn Areas Nos 2-43," which Bartaya compiled on the basis of his own many years' worth of observations.

Bartaya's work is distinguished by the great accuracy and uniformity of the material, which were furthered by the high quality of the spectra obtained under favorable climatic conditions for astronomy; careful development of the criteria for two-dimensional classification relative to the equipment used (a 70-cm meniscus telescope with an 8° objective prism) and closeness to the well known MK system of spectrum classification; the deliberately selected location of the sky sections that were investigated, which makes it possible to use the data in the "Catalog" (which has been recorded on magnetic tape) to solve stellar astronomy problems.

The thoroughly explained methodological part of the work, together with the critical summary of the problem, will be helpful to scientific workers specializing in stellar spectroscopy. The techniques proposed by the author are being used in a number of observatories, including some in the People's Republic of Bulgaria and the GDR. The taped "Catalog" is kept in stellar data centers.

The following can be noted from the conclusions drawn in the stellar astronomy section. The distribution pattern of the giant stars indicates the predominance of K and not G stars in the high galactic latitudes, as follows from the visible distribution of the stars. There is no actual shortage of giant stars in the spectral interval F-G5 in the high galactic latitudes. In all galactic latitudes, K and M stars are basically represented by giants. In many statistical works on stars in which, as a rule, there are no data from the two-dimensional MK classification, these stars have been listed in luminosity class V with inadequate substantiation.

A characteristic of the giant stars is a lighter concentration toward the galactic plane than was previously assumed, while for dwarf stars the concentration is heavier. This last conclusion is important, since it is related to the problem of the "hidden mass" of the Galaxy (ZENLYA I VSELENNAYA, No 3, 1975, pp 32-36).

Luminosity functions and star densities have been compiled for 42 directions in the Galaxy and the dependence of the luminosity function on galactic latitude has been investigated. Star luminosity functions have also been derived for separate classes of stars.

The technique that has been developed for distinguishing stars with peculiarities in their spectra has made it possible to discover dozens of new peculiar stars; in

addition, the nature of their spatial distribution in the Galaxy has been investigated, along with the position of A_p and A_m stars in the spectrum-luminosity diagram.

Tartu Astrophysical Observatory, Estonian SSR Academy of Sciences: The First Few Years of Using the 1.5-m Telescope

For Estonian astronomers, we can assume the happiest day in recent years to be 21 October 1976, when the main instrument of the Tartu Astrophysical Observatory (meni V. Struve -- a 1.5-m reflecting telescope (AZT-12) -- was solemnly put into operation. As is the case for other large telescopes in our country, the new reflecting instrument was designed and manufactured at the Leningrad Opticomechanical Association. The telescope is installed in a four-story tower. The plan for its dome was developed in the Special Design Office of the Estonian SSR Academy of Sciences. On the first floor of the tower there is a room for observers and measuring equipment for processing observational data; on the second floor there is a YeS-1010 computer; the telescope's control system and a workshop are located on the third floor; on the fourth there is the telescope itself and the control panels. The accommodations for a large spectrograph occupy three floors.

The telescope has a German mounting and the main mirror, which is 150 cm in diameter, is made of sital. The telescope has three foci: the primary focus (focal length -- 5.28 m, aperture ratio -- 1/3.5, photograph scale -- 1 s per 0.0256 mm), a Cassegrain focus (focal length -- 24 m, aperture ratio -- 1/16, photograph scale -- 1 s per 0.116 mm) and a coudé focus (focal length -- 52.8 m, aperture ratio -- 1/35.2, photograph scale -- 1 s per 0.256 mm). The work is done basically in the Cassegrain and Kude foci; changing the focus takes 2-3 min.

Tests of the telescope's optical system showed that at the Cassegrain and coudé foci, 96 and 89 percent of the energy, respectively, is concentrated in a circle 0.75" in diameter. This is fully adequate, so the telescope's practical resolution was determined only by the quality of the atmospheric image in the place where it was set up. Since it was known beforehand that the atmospheric resolution is low and the atmosphere's transparency is variable in Tyraver, the telescope is basically used for spectral observations with high-transmission spectrographs. During the "white" nights of summer, observations are made with an infrared photometer. The telescope's control system operates reliably.

The observation program encompasses spectroscopy of variable stars, stars in the most recent spectral classes, and galaxies. The astronomers use the data from the observations to determine the structure of stellar atmospheres and study evolutionary effects in stars. Observations of galaxies are still limited to measurements of red shifts.

The spectra are recorded on photographic plates and with the help of an OMA (possibly Department of Mechanization and Automation) television system that reproduces the spectrum's intensities on 500 channels in the color mode. Because of the use of the television system, the spectra of 10th magnitude stars with a dispersion of 12 Å/mm are obtained in 30 min, while the spectra of galaxies with 14th stellar magnitude brightness and a dispersion of 200 Å/mm are obtained in about an hour, while those of objects in which emission lines are visible are recorded (depending on the intensity of the line) considerably more rapidly.

Although the AZT-12 telescope has already been in operation for several years, the telescope complex -- emissions analyzers and recorders -- cannot be considered complete. The Leningrad Opticomechanical Association is building a large spectrograph that will work at the coude focus. We hope to receive this spectrograph in 1985. We are also working on the introduction of new sensitive and stable emissions receivers and creating an automatic observation processing system.

Astrophysics Institute, Kazakh SSR Academy of Sciences: Investigations of the Atmospheres of Jupiter and Saturn

The two largest planets in the solar system -- Jupiter and Saturn -- are being investigated intensively from both the Earth and space. In our country, projects for the study of these planets is coordinated by the Kazakh SSR Academy of Sciences' Astrophysics Institute.

In recent years, an extensive program of spectrophotometric observations of Jupiter and Saturn over a broad spectral interval (from 0.3 to 1.1 μm) has been carried out in the institute's Planetary Laboratory. In the observations we used a spectrograph with an electronic-optical converter and a diffraction scanning spectrometer, which makes it possible to obtain both photoelectric recordings of the spectra of separate sections of a planet's disk and photometric profiles of a disk on any wave length and in any direction.

Measurements in the continuous spectrum and in methane absorption bands have been used to determine the optical characteristics of Jupiter's and Saturn's cloud belts and investigate variations in the cloud cover's density with latitude and the optical thickness of the atmosphere belt above the clouds. As it turned out, on both planets the aerosol component reaches considerably higher than the convective zone's theoretical boundary and forms a comparatively rarefied haze above the denser layer of ammonia clouds. In Saturn's equatorial belt the upper limit of aerosol dissemination is about 8-13 km higher than in the middle latitudes. Such a result follows from both observed changes in the intensity of the molecular absorption bands and from differences in the reflective capacity of Saturn's bands for ultraviolet rays. On Jupiter there are also changes in the intensity of the molecular absorption bands with latitude; these are particularly noticeable in the methane bands in the near-infrared part of the spectrum. These changes are related to fluctuations in the altitude of the clouds' upper boundary and intensity. The Great Red Spot on Jupiter appears to be very bright during observations in the methane absorption bands, which is probably the result of a higher volumetric density of the aerosol substance in the Spot than in the surrounding sections of the cloud cover.

In the polar areas of Jupiter we have detected special features of its reflective properties that indicate that in these areas the aerosol is located at higher altitudes in the atmosphere. Since it is a strong absorber of ultraviolet radiation, aerosol in the upper atmosphere results in a significant lowering of Jupiter's reflective power in the high latitudes so that, in contrast to the low-latitude belts, the molecular (Rayleigh) scattering in the atmosphere above the clouds is almost imperceptible. This result has been confirmed by observations of eclipses of Jupiter's satellites and photometric measurements made by the "Voyager-2" spacecraft in the far section of the ultraviolet spectrum (at a wave length of 2,400 Å). Similar features have also been noted in the polar regions of Saturn, the

ultraviolet ray brightness of which is considerably less than the brightness of the rim sections of the planet's disk in the middle and low latitudes. The aerosol in the upper atmosphere above the polar regions of Jupiter and Saturn can be of either photochemical or meteoric origin; in the latter case it forms during the disintegration of meteoric bodies falling into the atmosphere or from dust matter in space near the planets. By absorbing solar radiation, this aerosol can cause additional heating of the upper layers of the atmosphere in the polar regions (which, incidentally, is also observed during measurements of these regions' thermal emissions at a wavelength of about $12\ \mu\text{m}$).

State Astronomical Institute imeni P.K. Shternberg: A Radioastronomy Survey of the Sky

The RATAN-600 Radioastronomy Laboratory has been set up at the State Astronomical Institute imeni P.K. Shternberg. The similarity of the names of this laboratory and the unique radiotelescope at the USSR Academy of Sciences' Special Astrophysical Observatory is no accident. The laboratory's basic assignment is a complete survey of the sky with the RATAN-600 for the purpose of compiling a catalog of discrete sources of cosmic radio-frequency emissions.

All of the radio source catalogs now in existence, which encompass significant areas of the sky, are based on observations that were made in the decimeter wave bands. Only limited sections of the sky have been surveyed at shorter wavelengths.

The first optical identifications of radio sources have already shown that most of them are of extragalactic origin. Consequently, sky surveys are important not only for the detection of separate interesting objects and their further study by modern astrophysical methods, but also for investigating cosmological problems. Another important result of the surveys was the establishment of the fact that as the wavelength decreases, the average spectral characteristics of radio sources change. Although the radio sources detected in the long-wave band have predominantly normal spectra (that is, they are sources whose flow decreases as the wavelength does), in the short-wave band there is an increase in the number of sources with peculiar spectra (distorted, flat, rising). The properties of these sources -- in particular, their spatial distribution and the nature of the dependence of their number on the density of the flow of radio-frequency emissions -- can differ from the properties of sources with normal spectra.

It has been decided to survey the entire sky in the RATAN-600's southern sector in the centimeter band and simultaneously on several other wavelengths. This is the first project of its type to be implemented, and it is making it possible to obtain (in addition) information about the instantaneous spectra of radio sources that have been detected.

A specialized radioastronomy complex was built in the laboratory in 1978-1979. It consists of radiometers for the 2.05-, 3.45- and 7.6-cm bands (built by V.R. Armirkhanyan's group), an information collection system (developed under the leadership of M.G. Larionov) and an M-400 computer. Data entered in the computer is processed in the real-time mode according to algorithms proposed by the author of this article. Modern methods of recording signals make it possible to make full use of the radiotelescope's capabilities.

Regular observations began in March 1979, and by May 1980 they had covered a band of the sky in the range of declinations from 0° to 6° . Most of the previously unknown sources (200 out of 600!) were discovered on a wavelength of 7.6 cm. Among the new sources there are many elongated objects that are apparently galaxies. All of the 32 new objects discovered on a wavelength of 3.45 cm have peculiar spectra, in full accordance with the predictions. They are most likely quasars. A final conclusion on the nature of the radio sources that have been discovered can be made only after optical identification.

The sky survey is continuing at the present time. Although the first results are giving us food for thought, basically we are still gathering information for further research. We expect that in the next year or two the number of newly detected sources will be sufficient for a study of their spatial distribution. The survey of the entire part of the sky visible to the RATAN-600 will take approximately 10 years, even under favorable conditions.

Sayan Solar Observatory: Evolution of an Active Complex on the Sun

The readers of this magazine know how important the prediction of flare activity on the Sun is for everyday life. Flare observations are now being made according to the international "Year of the Solar Maximum" program (ZEMLYA I VSELENNAYA, No 4, 1980, pp 33-37). During the period of operation of the "Release of Energy in Flares" (SYERF) program, an active complex was observed on the Sun's disk from 4 to 9 April 1980. It consisted of two groups of spots with a total area of 1,240 mdp (mdp = millionth part of the solar hemisphere = unit of measurement for the area of sunspots) in which several large flares occurred. The flares were observed by the Sayan Observatory of the USSR Academy of Sciences' Siberian Department's Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (the observations were made by V.S. Bashkirtsev and G.P. Mashnich on an ATsU-5 solar telescope).

On 2 April 1980, spot group No 2363 (the numeration of the international center at the Goddard Spaceflight Center in the United States) was observed on the Sun; it had magnetic field gradients of less than 0.5 G/km. On 3 April the weather was not favorable for observations. On 4 April the solar chromosphere above the spots was distinguished by increased activity, while the line of separation of the magnetic fields' polarities (the neutral line) was parallel to the solar equator. On subsequent days group No 2363 belonged to the "closed" type, as before, with the configuration of the magnetic fields being indicative of flare activity in the group.

On 5 April a new group, which was subsequently labeled No 2372, began to form near this group. At 0300 h (here and subsequently, universal time is used) there appeared numerous cells with rudimentary penumbras. The main spot and the cells in the rear part of the group, all of which were united by a common penumbra, formed in 4 h. Observations on the H_{α} hydrogen line showed that in the chromosphere a bright, compact floccule, the luminosity of which was undergoing rapid changes, was shining. A note of interest here is that, as observers mentioned, the chromosphere in the area of group No 2372 was completely quiet. On 5 April the Consultative Center for the Conduct of the Program "Year of the Solar Maximum" (in Irkutsk) directed that developing group No 2372 be a target of further observations on the part of the entire worldwide network of observatories.

On 6 April group No 2372 appeared to be a powerful, developed active area with two large main spots with complex structures and a bright, compact floccule shining in the chromosphere. At 0416 h the observers at Sayan Observatory detected visually a flare in the white light near the rear spot in this group that lasted for at least 75 min. The Consultative Center in Irkutsk notified all observatories worldwide of this rare event -- flares in white light are a power manifestation of solar activity and are usually seen only two or three times in an 11-year cycle. Low-power subflares were seen in this group for a day after the white light flare.

On 7 April there was a new flare, observed on the H hydrogen line, in this same active area.

On 8 April active area No 2372 "generated" two more large flares (at 0013 and 0308 h) that occurred at an interval of 3.5 h. The same day, at 0304 h, a radio burst that lasted for 30 min on a wavelength of 5 cm was recorded.

The flares on the Sun of 6 and 8 April 1980 were the first most powerful flares in the 21st cycle of solar activity.

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TURBULENCE IN THE ATMOSPHERE OF VENUS AS DETERMINED FROM FLUCTUATIONS IN RADIO WAVES EMITTED BY THE 'VENERA-9' AND 'VENERA-10' STATIONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 775-782
manuscript received 11 Nov 79

TIMOFEYEVA, T. S., YEFIMOV, A. I. and YAKOVLEV, O. I.

[Abstract] The "Venera-9" and "Venera-10" stations are used for radio illumination of Venus's atmosphere in the 32-cm band, with a range of parameters that varied widely. On the basis of an analysis of the data that were obtained, the authors conclude that the turbulence in Venus's atmosphere can change from day to day by as much as 50 percent of its average values. There are also two areas of increased turbulence, at altitudes of 42-50 and 57-65 km, characterized by high temperature gradients, wind speeds and dispersions of fluctuations in the amplitude logarithm with respect to height. Figures 5; references 12: 9 Russian, 3 Western.
[46-11746]

THE VERTICAL TEMPERATURE GRADIENT IN THE ATMOSPHERE OF VENUS AS DETERMINED FROM RADIOSCOPY DATA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 783-786
manuscript received 11 Nov 79

MATYUGOV, S. S., CHUB, Ye. V., YAKOVLEVA, G. D. and YAKOVLEV, O. I.

[Abstract] The "Venera-9" and "Venera-10" stations were used for radioscopy of Venus's atmosphere, from which data information on the vertical temperature gradient were obtained for both day and night periods. Using figures, the authors show the dependence of temperature on altitude for both the day and night periods for different radioscopy sessions. The minimum gradients, which were almost isotherms, were seen at altitudes of 61-64 (diurnal) and 65-70 (nocturnal) km. The maximum gradients were seen at altitudes of about 55 km. Figures 2; references 9:
8 Russian, 1 Western.
[46-11746]

UDC 612.821.6

REACTIONS OF RATS TO BEHAVIORAL PROBLEMS OF VARIOUS DEGREES OF DIFFICULTY AFTER FLIGHT ON THE 'COSMOS-782' BIOSATELLITE

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI in Russian Vol 30, No 3, May-Jun 80 pp 507-512 manuscript received 5 Mar 79

LIVSHITS, N. N., MEYZEROV, Ye. S., APANASENKO, Z. I. and KUZNETSOV, N. A., Moscow

[Abstract] Research was done on small shifts in higher nervous activity of rats in early and later post-flight periods after 19.5 days in orbit on the Cosmos-782 biosatellite. Each animal was compared with two control animals with similar preflight characteristics. The rats were conditioned for solving maze problems. The experimental results were statistically analyzed. In solving a simple maze, the experimental animals were not as easily distracted by an extraneous stimulus (a bell) as the control animals. The experimental animals were also better able to withstand repeated runs through a maze than the control animals up to the 13th day after the flight. However, in solving a completely new maze, the experimental animals performed like the control group on the first run, but did much worse than the control group on subsequent runs. It is concluded that such performance is due to exhaustion of higher divisions of the central nervous system in rats exposed to spaceflight conditions. Figures 4; references 9: 7 Russian, 2 Western. [9644/0780-6610]

UDC 612.83.015.348.014.477:629.78

EFFECT OF ARTIFICIAL GRAVITY DURING SPACE FLIGHT ON PROTEIN AND RNA CONTENT OF SPINAL CORD MOTONEURONS IN THE RAT

Moscow BYULLETEN' EKSPERIMENTAL'NOY BIOLOGII I MEDITSINY in Russian No 9, 1980 pp 372-375 manuscript received 13 Feb 80

GORBUNOV, A. V. and PORTUGALOV, V. V., Laboratory of Neurohistology imeni B. I. Lavrent'yev (headed by Prof V. V. Portugalov, corresponding member of the USSR Academy of Medical Sciences), Institute of Normal Physiology imeni P. Yu. Anokhin, USSR Academy of Medical Sciences, Moscow

[Abstract] A study was made to determine the cause for the metabolic changes previously observed in the spinal reflex arc of rats flown aboard the "Cosmos-936"

biosatellite for 18.7 days. Samples of spinal cord tissue 2-3 mm in thickness were taken from 10 rats who spent the 18.5 days in weightlessness and 9 rats kept on a centrifuge during the space flight. The techniques for isolation of motoneurons, measurement of dry cytoplasm, RNA content, motoneuron nucleus weight, cell and nucleus volume are described. Ten vivarium rats served as a control. The tissue samples were collected 4.5-9.5 h and 25 days after the flight. At the early stage there was a decrease in volume of motoneuron bodies and nuclei of flight rats, higher concentration of RNA, lower protein content of motoneuron cytoplasm and nuclei in flight rats, than in the control. Most parameters reverted to normal after 25 days (protein content of motoneuron nuclei was above control level). Differences in the changes between weightlessness and artificial gravity (centrifuge) are discussed, it being less marked in the latter case. The suggested cause of protein decrease in motoneuron cytoplasm and nuclei is due to changes in the functional state of neurons in weightlessness, probably due to a decreased flow of information delivered from skeletal muscles and bones. Tables 3; references 5: 4 Russian, 1 Western.

[95-10,657]

SPACE ENGINEERING

EFFICIENCY OF SPACE TRANSPORT OPERATIONS

Moscow ZEMLYA I VSELENNAYA in Russian No 1, Jan-Feb 81 pp 24-27

[Article by N.N. Rukavishnikov, twice hero of the Soviet Union, Pilot and cosmonaut of the USSR and candidate of the Engineering Sciences]

[Text] The next space expedition is ready for launch and the cargo which must be delivered into orbit has been packed. What is the most efficient solution of the problem of space transport? The "Soyuz T" craft will help to make transport operations in space more efficient.

Transport Efficiency

Any kind of transportation is more efficient the smaller the ratio of the weight of the packaging to the useful payload weight. In other words: the more favorable this is, the less expensive the cost of a transport operation will be. We shall take a look from this point of view at the customary means of ground transportation which are familiar to us. The "Volga" compact car with an empty weight of about 1,400 kg was designed to carry five passengers and a load of about 50 kg. If the weight of one passenger is taken as 70 kg, then the overall weight of the load being carried proves to be 400 kg. The ratio of the weight of the load being carried to the overall weight of the transport vehicle and the load being carried can be considered to be the efficiency of the transport vehicle. Thus, the value of the efficiency for the "Volga" automobile is about 0.22 and the efficiency of a truck averages 0.5, while that of a commercial railroad car is about 0.75, since for a tare weight of about 20 tons, the load capacity of such a car is 60 tons. And if a man rides a bicycle, then the efficiency of a such a transportation system is even higher: about 0.8. In this case, the man is the useful payload while the bicycle is the means of transport.

It is now clear to us that the efficiency of a means of transport reaches unity only when this means actually does not exist, while the useful load travels by itself. Thus, for example, if a raft floats with the current, then it can be said that the efficiency of such transportation is equal to unity.

To be sure, other criteria also exist for the evaluation of the efficiency of a means of transport. These are primarily the transportation reliability, or the probability that the load will be delivered to the right place; the transportation time, i.e., how long we will have to wait for the load at the designated point; the convenience for passengers; the simplicity of control of the means of transport, etc.

We shall attempt to evaluate the existing means of space transport from the viewpoint of the criterion we have chosen, since for a specified degree of reliability, the mass ratios play a primary role in space. The "Soyuz" transport ship with an actual mass of about 6,800 kg at the moment of docking with the "Salyut" orbital station has two cosmonauts and 100 kg of cargo on board. We shall assume that the weight of a cosmonaut in flight gear is 100 kg. Then the weight of the payload delivered into orbit in the "Soyuz" ship will be 300 kg. Calculating the efficiency yields a value of 0.044. This is without taking into account the weight of the rocket vehicle (otherwise, the efficiency will prove to be extremely lower).

Why is it so low? This is approximately one-fifth the efficiency of a passenger automobile and less than one-seventeenth of the efficiency of a freight car. Yes, unfortunately, this proves to be true despite the fact that the ship is fabricated using the most advanced technology and especially strong and light structural materials are used as well as modern radio electronic equipment, highly efficient fuel for the rocket engines of the ship and even despite the most precise ballistic calculations which makes it possible to achieve the maximum savings of this fuel.

The mechanics of space flight is responsible for this. In the powered phase of the flight, when the ship is launched into orbit, as well as during braking in the dense layers of the atmosphere during descent, the ship experiences considerable inertial loads. For example, if an accident occurs to the rocket vehicle during the insertion of the ship in orbit, and its engines cut out, then the spacecraft, having separated from the rocket, will enter the earth's atmosphere at an angle it was not designed for. Then the collision with the rarified air of the upper layers of the atmosphere will be so strong that overloading of the craft can occur, exceeding the force of the earth's gravity by a factor of more than 20 times. The spacecraft designers should take this into account. This is responsible for the large inherent weight of the structure. Let us take, for example, the cosmonaut's seat. As we already know, the weight of a cosmonaut is about 100 kg, and with an overload by a factor of 20 times, this becomes two tons. And the seat must sustain such a load. Such rigorous requirements are not placed on the driver's seat in any kind of ground transport.

The specific features of space flight also determine the complexity of the control system for the operation and motion of the spacecraft. This is related to the fact that the spacecraft has six degrees of freedom in its motion (an

automobile has two degrees and a railroad car has one degree of freedom overall). Moreover, all of the on-board equipment, the instruments, units and systems, should be very reliable, since it is impossible to shut-down for repairs in space flight. This means that a back-up is needed for the most important parts of the equipment. In the "Soyuz" ship, many of the radio electronic equipment devices are duplicated, and sometimes, even provided in triplicate. The "Soyuz", for example, has two cruise engines: in case one suddenly fails . . .

One must also take into account the fact that a manned spacecraft is designed not only for delivering the crew and the cargo into orbit, but also for returning them from orbit. For this reason, the descent equipment of the ship should have strong heavy duty thermal protection for the craft, so as to stand up to the ultrahigh temperature of the plasma flow washing around the craft during aerodynamic braking in the atmosphere. The re-entry craft has a reliable back-up descent system using parachutes and a soft landing system including altitude meters, electronic equipment and powder fuel rocket engines for the soft landing.

After landing on the earth, the descent vehicle can also serve as a home for the crew in which they must live until the arrival of the search and rescue service, as well as sea vessel, if they have landed in the ocean, with the requisite stability, positioning of the center of gravity, buoyancy, communications and signalling gear, outboard water cooling system, etc. And all this is weight, weight, weight, . . .

An example can be cited which shows how much the means of returning a craft to earth costs (in kilograms of course). Everyone is well aware of the "Progress" cargo spacecraft, which makes trips into orbit to deliver various cargos to the "Salyut" orbital station: fuel, water, food, oxygen, new instruments and assemblies as well as scientific equipment (ZEMLYA I VSELENNAYA, 1978, No. 5, pp 12-17 - Editor). This ship was made as a nonreturnable craft. With an inherent weight at the moment of docking with the station of about seven tons, this ship carries about 2.3 tons of payload on board. In estimating this means of transport in accordance with our criterion, we find that its efficiency is 0.34 (again we do not take into account the weight of the rocket vehicle), and this figure is now comparable with the efficiency of an automobile, which is quite good. After the delivery of the cargo into orbit, the "Progress" is used to remove the units and accessories from the station which have served out their life, as well as various wastes which have accumulated during several months of the mission. After unloading the ship, the crew of the orbital station fills its compartments with these objects and then undocks the "Progress" from the station, and brakes it in orbit, as a result of which it loses altitude and enters the atmosphere above the Pacific Ocean. Not having a thermal protective coating, the ship does not survive the violent flow of the incandescent plasma and is destroyed, while its individual components change into a metal vapor. Only the largest and heaviest parts can reach the ocean, but if this is so - who knows?

Space transport is a rather expensive transport. Its cost is governed not only by the cost of fabrication, but also by the operational cost. Reducing the operational cost of space transport is just as urgent a problem as increasing its operational efficiency. Control of a space flight is a complex matter. The mission is supported by the operation of a large number of ground tracking stations, sea-going measurement complexes (ships of the "Kosmonavt Yuriy Gagarin" and "Akademik Sergey Korolev" type, etc.). Ballistic computer centers and mission control centers participate in the control of the flight. Numerous ground and satellite communications channels are employed. All of these facilities contain a large amount of expensive equipment, which is serviced by highly skilled specialists (ZEMLYA I VSELENNAYA, 1980, No. 1, pp 37-42 - Editor).

The "Soyuz T" in Space

The "Soyuz" which was designed at the end of the 1960's (ZEMLYA I VSELENNAYA, 1978, No. 5, pp 6-7 - Editor) takes the form of a multipurpose spacecraft, which was intended for use in the execution of independent missions as well as for the performance of transport operations. The latest and most advanced engineering and design solutions at that time were embodied in the "Soyuz" craft. The radio electronic equipment of the ship was designed around a modern component base and advanced technology was used in its manufacture. New methods of prelaunch ground tests were created. All of this resulted in the successful operation of the craft for more than 10 years. The different variants of the "Soyuz" were also used to execute the first docking of spacecraft in orbit in the world, something which led to the creation of the manned experimental orbital scientific station consisting of the "Soyuz-4" and "Soyuz-5" (ZEMLYA I VSELENNAYA, 1969, No. 1, 2nd page of the flyleaf - Editor), as well as the "Soyuz-9", "Soyuz-13" and "Soyuz-22" for missions as independent research laboratories (ZEMLYA I VSELENNAYA, 1970, No. 4, p 3; 1975, No. 3, pp 2-7; 1977, No. 2, pp 2-15 - Editor). It was also used to make the world's first international spaceflight of the "Soyuz--Apollo" in the world in 1975 (ZEMLYA I VSELENNAYA, 1975, No. 4, 2nd page of the flyleaf - Editor). The "Soyuz" spacecraft delivered and are delivering cosmonauts to the "Salyut" station. This has supported the work of international space crews in space consisting of cosmonauts of the Soviet Union and other socialist nations, as well as the execution of space expeditions in orbit of lengths unprecedented in the history of world space flight (ZEMLYA I VSELENNAYA 1978, No. 5, pp 17-23 - Editor). The "Soyuz" craft has been in service for more than ten years. It executes its functions with a high degree of reliability. Nonetheless, the "Soyuz" is becoming obsolete at the present time. New technological methods have now appeared in production as well as new materials, and even radio electronics is today quite different.

It became necessary to design a new generation of manned transport spacecraft. It was essential that the efficiency of transport operations be increased. Soviet space equipment has now been supplemented with the new "Soyuz T" craft, the successful flight trials of which in the manned variant were carried

out for the first time by Yu.V. Malyshev and V.V. Aksenov in June of 1980 (ZEMLYA I VSELENNAYA, 1980, No. 5, pp 3-7 - Editor).

The factors presented above which improve the efficiency of transport operations were taken into account in the "Soyuz T". The radio electronic equipment of the ship, the weight of which is quite considerable, was designed around a new component base, something which made it possible to not only reduce the size and weight of the on-board equipment, but to increase the reliability of the entire complex. An all-purpose digital computer was used for the first time in the control system for the on-board equipment complex; this computer was the basis for the creation of the spacecraft digital computer complex (BTsVK) [SDCC]. So that during the mission, the ballistic problem of spacecraft approach to the station can be solved on-board. The reliability of approach and docking has been increased and substantially less fuel is expended when the transport craft makes the approach maneuvers; for each kilogram of fuel left behind on earth is converted to kilograms of payload delivered into orbit.

The use of the SDCC has made it possible to solve the problems of controlling the operation of the on-board complex and monitor its operation in a new manner. It is sufficient to merely enter the "flight mission" into the SDCC, and the system itself begins to execute the operations sequentially at the requisite time: it turns on all of the requisite instruments and units - and the ship executes various kinds of orientations, maneuvers as well as approach and docking to the station. During the control time, the course of the operations and the system functioning are comprehensively monitored. In case a defect is detected, the SDCC can either switch the system over to standby instrument sets or select a spare variant for the execution of a given operation, or finally, shut down the equipment and eliminate all operations if there is no other way out. The SDCC informs the crew of all of its actions. The messages from the SDCC are displayed on the instrument panel of the ship through a system for SDCC information exchange with the crew. The cosmonauts have the capability of using the SDCC in two modes: automatic and semiautomatic. In the first mode, the SDCC only informs the crew of its actions, while the crew performs the function of the main controller in this case, who always can intervene in the process. In the second mode, to execute each new step in the control program, the SDCC must obtain the approval of the crew. In this case, the on-board digital computer complex displays the word "I want" on the screen and thereafter that which it wants to do automatically. For example, the message "I want the engine" appears. This means that the SDCC wants and is ready to turn on the cruise engine of the craft for a trajectory correction in its motion. If the pilots agree with the decision of the SDCC (they have their own criteria for estimating the timeliness and necessity of doing this), then they give the command enabling the SDCC to execute the prepared action: turning on the engine. The case of complete failure of the SDCC is also covered. In this situation, the crew turns on a manual control circuit for the operation of the on-board systems and execute the operations in a manner similar to the way it was done in the "Soyuz" craft. Moreover, the SDCC generates information on the functioning systems of the ship,

as a result of which, the crew obtains information in a generalized form, something which reduces the load on the crew and the probability of errors in monitoring and control. The process data is fed to ground to the mission control center via telemetry channels. This makes it possible to simplify the cumbersome and expensive mission control service, thereby increasing the efficiency of the execution of transport operations to deliver loads to the station. And the use of the SDCC in the "Soyuz T" ship will undoubtedly substantially simplify the work of the crew.

A new propulsion plant is used in the "Soyuz T" ship. The cruise engine and the orientation engines in it receive fuel from common tanks, something which makes it possible to efficiently utilize the fuel supply. The life support system and electrical power supply system for the ship have been subjected to a substantial revision. This is why the design of the "Soyuz T" transport ship represents a new important step in spacecraft construction.

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[55-8225]

8225
CSO: 1866

TEST OF AN EXPERIMENTAL TWO-SIDED SOLAR BATTERY ON BOARD THE 'SALYUT-5' ORBITAL STATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18, No 5, Sep-Oct 80 pp 812-814
manuscript received 26 Mar 79

BALTYANSKIY, G. A., BORDINA, N. M., DALETSKIY, G. S., YERMAKOV, V. G., ZAYAVLIN, V. R.
LETIN, V. A. and KHOLEVA, M. N.

[Abstract] A solar battery in orbit should have two sensitive sides so that it can utilize both direct solar radiation and solar radiation reflected from the Earth. A comparative test of experimental solar batteries (one with single-side sensitivity and one with two-side) was conducted on board the "Salyut-5" orbital station. The batteries consisted of silicon photoconverters on a lattice-type substrate. The rear side of the two-sided battery received 34 percent as much reflected radiation as the front side did direct radiation, and the average current produced by this battery was 17 percent more than that produced by the one-sided battery. The authors conclude that the use of such a two-sided battery in a polar orbit will result in an increase in power of up to 30 percent. Figures 1; references 4: 3 Russian, 1 Western.

[46-11746]

SPACE APPLICATIONS

DIRECTOR OF STATE CENTER 'PRIRODA' ON EARTH SURVEYS FROM SPACE

Moscow Domestic Service in Russian 0830 GMT 7 Mar 81

[Interview with Director of State Research Center "Priroda" Yuriy Pavlovich Kiyenko by Lyudmila Shvedtsova]

[Excerpts] The country's scientists are processing information received from the "Salyut-6" orbiting station which has been in operation for over three years in near-earth space.

Our correspondent Lyudmila Shvedtsova talks to Yuriy Pavlovich Kiyenko, director of the State Research Center "Priroda":

[QUESTION] "Salyut-6" has probably given you a lot to do?

[ANSWER] Of course, a lot of work not only for the staff of the State Center "Priroda," but also for many sectors of the national economy. While at the beginning of the 10th FYP-period only a few organizations used space photographs, in 1980 their number was in excess of 600. And the amount of data annually handed over to the national economy is hundreds of thousands. Among the important properties of space information are the huge areas covered—from several km to thousands of km, and the high productivity and promptness which makes it possible to obtain in a short time information about hundreds of thousands of sq. km of land, sea or oceans.

Thus, for instance, from orbit one can simultaneously observe Lake Baykal and Kamohatka. In five minutes of satellite flight one can photograph a territory which a modern aircraft would take two years of continuous work to survey.

While quite recently a journey beyond the Polar Circle or into the Antarctic was a heroic feat, with the aid of space facilities these regions can be surveyed, while, say, in a Moscow laboratory.

With the application of space equipment the concept itself of difficulty of access has lost its basic meaning. All this is clear evidence that the development of cosmonautics has ensured the implementation of a scientific and technical revolution in the study of the Earth's natural resources and in monitoring the state of the environment.

Using materials from space photographs the geological structure of our country is being studied; deposits of oil, gas, ore raw materials are being looked for; mapping of the Pamirs and Tyanshan, the BAM route, Chukotka, Western Siberia and the islands of the Arctic Ocean is being carried out; forest areas, land resources, the shelf zones of the seas and the ice situation on the Northern Sea Passage are being surveyed and tens of other tasks are being solved.

The coordinated study of natural resources using space photographs is especially important in connection with the development of existing and the creation of new territorial-production complexes, primarily in areas of Siberia and the Far East.

|QUESTION| We are already beginning to talk about the significance and about the return from work in space. How does this express itself specifically if we talk of physical geography?

|ANSWER| Quite a few examples of effective use of data can be cited. For instance, quite recently a well drilled on the basis of data received from space produced commercial gas. Another example: in one of the regions of our country, construction of large mining complex is in progress. The area where this complex is being set up was studied from the materials of a space photograph with a view to determining the seismic danger of the territory. You know that it is very important to establish a correct approach to evaluating the seismic danger of a territory. If we underestimate it, any earthquake can lead to a catastrophic result. At the same time it is harmful to overestimate this danger as in that case huge funds would have to be invested in building structures so as to make them excessively strong. And so the correct evaluation of the seismic danger of the territory in question resulted in the planned cost of work, which had been based on assumption of a greater seismic danger than was the case in reality, being lowered by R.40,000,000.
[81-F]

CSO: 1866

AZERBAIJAN INSTITUTE OF SPACE RESEARCH FOR NATURAL RESOURCES

Baku BAKINSKIY RABOCHIY in Russian 28 Jan 81 p 2

[Article by T. Ismailov, winner of the State Prize of the Azerbaijan SSR, doctor of the engineering sciences, and director of the Institute of Space Research for Natural Resources of the Republic Academy of Sciences: "Science for the Five-Year Plan. The Youngest Institute"]

[Text] The Institute of Space Research for Natural Resources, which was created at the initiative of the Central Committee of the Azerbaijan Communist Party, is the first scientific institution in this field in the world and the youngest institute of the academy of sciences of the republic.

Its activity is of a broad and multifaceted nature. It involves working out the physical and engineering principles of space studies of the globe's natural resources, the design and implementation in the national economy of a complex of scientific instruments for remote sensing of the planet, specialized satellite ground data and instrumentation systems, as well as the hardware for the interpretation of the information which is received from space. A great deal of work is being done in the "Interkosmos" program in close cooperation with almost all socialist nations.

The institute today is the chief organization for the implementation of a number of union and international programs. An economic impact of 7 million rubles resulted from the introduction of 13 of its completed developments in 1980 alone. For its success in socialist competition, the institute has twice been awarded the challenge Red Banner of the Central Committee of the Azerbaijan Communist Party, the Council of Ministers, as well as the council of trade unions and the Central Committee of the Komsomol of the republic.

What has been done by our collective in the 10th Five-Year Plan once again convincingly confirms the fact that the application of space techniques to the solution of large scale research and practical national economic tasks is to be numbered among the most important achievements of modern science and engineering. The study of the planet from space is a new direction, a new epoch in the development of very many fields of knowledge, primarily physics, mathematics, cybernetics, biology and earth sciences. The solution of urgent

problems in geology, agriculture, prospecting for useful minerals, monitoring the status of the environment, studying water and forest resources as well as the world ocean using the tools of space engineering is being accomplished in an efficient manner of significantly more economically than with traditional ground based on aerial methods.

For example, take such a purely scientific problem, at first glance, as the development of a technique for remote sensing of the earth. It would seem that only by having a ready-made procedure can one obtain particular applied results for utilization in the national economy. But in the development of our programs, so-called intermediate results were obtained, from the viewpoint of the final goal, the realization of which already promises a perceptible economic and ecological impact. We have in mind here the "Neftechala" program. Its major goal was the determination of the level of salinity of any solonchak soils, which are unsuitable at the present time for agriculture. But in the process of doing the work, scientists were able to make specific recommendations for the reclamation and introduction into the agricultural cycle of a portion of the land of the Neftechalinsk region, for the extraction from drainage waters, as well as from the effluents of an iodine and bromine plant of cooking salt, boron and other valuable components, the utilization of which will permit an annual profit of up to 30 million rubles. Simultaneously, the entry of substances harmful to water fauna and flora into the Caspian and Kura was successfully prevented.

One could also relate the facts involving the prospecting for useful minerals, the protection of the air basin, etc.

The Institute of Space Research for Natural Resources, with its design organizations and experimental plant, today essentially is an academic scientific production association which has come into being. It is well known that a scientific production association is the most efficient organizational form for the design and rapid production mastery of new items, which provides for thorough planning at all stages: from concept to introduction. Because of such a modern formulation and resolution of questions in scientific and engineering progress by the institute, an entire set of instruments and systems have been developed for earth study from space. And the role of the institute is being performed in a new way in the promising development of new sectors of electronic machine making in the republic. The issue here is the possibility and necessity for creating a territorial scientific production complex in Azerbaijan for the design and series production of instruments and systems for earth study from space.

Our staff has confidently entered into the 11th Five-Year Plan, in an excellent mood. From the very first days of 1981, the year of the 26th CPSU Congress and the 30th Congress of the Azerbaijan Communist Party, scientists and specialists are energetically working on one of the most important problems put forward in the major work plan: this is specifically how it is valued in the party document, "further study and mastery of outer space in the interests of expanding science, engineering and the national economy". In the coming years, fundamental sciences will play an increasingly visible part in the transforming activity of man.

[61-8225]

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CSO: 1866

COMMENTARY ON RESEARCH PROGRAM OF 'INTERCOSMOS-21'

Moscow IZVESTIYA in Russian 8 Feb 81 p 6

[Article by B. Konovalov]

[Excerpt] Studies of the ocean and identification of regions rich in plankton by remote methods occupy a very important place in the flight program of this new satellite of the socialist alliance. For example, with the aid of an SHF radiometer developed at the Institute of Radio Engineering and Electronics of the USSR Academy of Sciences the temperature of ocean and land surfaces will be measured in a radio range unaffected by changes in weather. Images of earth will be transmitted by telemetry channels from the satellite in visible and infrared light using the MKS-6 remote sensing apparatus manufactured in the GDR.

A very important role will be played by the referencing of these images to specific characteristics of regions in the USSR, GDR, Bulgaria, Hungary and Czechoslovakia where will be located so-called "buoys" which will transmit through the satellite general and specialized (e.g. geophysical) data on conditions in their areas. In the future such "buoys" will be placed in areas with difficult accessibility.

One of the "buoys" in the present experiment will be located at sea. A special research ship of the Marine Hydrophysics Institute of the Ukrainian SSR Academy of Sciences has put out into the Atlantic with specialists from the socialist countries on board to conduct joint experiments with the satellite.

Development of a universal system for collection and transmission of data will occupy a central place in the experiment with this new satellite of the "Inter-cosmos" series. Data will be collected by the satellite from the "buoys" equipped with various scientific apparatus and will be transmitted to one of the receiving points of a unified telemetry system located on the territory of the countries participating in the experiment.

"Intercosmos-21" is a multipurpose orbital laboratory designed for study of our planet and near-earth space. The satellite's apparatus was created jointly by specialists from Hungary, the GDR, Romania, the USSR and Czechoslovakia.

[77-P]

FURTHER COMMENTARY ON 'INTERCOSMOS-21'

Tallinn SOVETSKAYA ESTONIYA in Russian 8 Feb 81 p 3

[TASS Scientific Commentary]

[Text] The first signals from near-earth orbit have been reached at group stations of the socialist countries participating in a new experiment in complex study of the world ocean and surface of the earth. The main instrument of the experiment is the "Intercosmos-21" satellite launched on 6 February from a Soviet cosmodrome.

According to V. Balebanov, deputy director of the USSR's Academy of Sciences' Institute of Space Research, the study of the ocean and earth's surface with the aid of space apparatus is one of the most important directions of the "Intercosmos" program. Methods for such studies were developed during expeditions on the "Salyut-6" station and with the "Cosmos-1076" and "Intercosmos 20" satellites. All of these experiments were related to the further deepening and expansion of studies in remote sensing of the earth from space.

The goal of the present operation is to develop methods for automatic collection and operational transmission through satellite from large areas of the world ocean as well as from remote points on the earth's surface. To accomplish this, the "Intercosmos-21" carries a system for collection and transmission of information (SSPI). Floating stations have been set out in various regions to measure, for example, water temperature at various depths, salinity and current speed. In addition, there are ground-based platforms. Each of these units collects data required by scientists and then, on command from the satellite as it flies over the area, transmits the information to a satellite where it is recorded on tape. The satellite then retransmits the information to a special data collection center or to one of the receiving points of the unified telemetry system (YeTMS) which are located on the territory of the countries participating in the experiment.

Thus, the global information becomes rapidly available for operational use by the scientists. This is very important for following the dynamics of many natural processes taking place at points of the earth that are of interest to us. The equipment of the SSPI is the fruit of joint work by specialists from Hungary, the GDR, the USSR and Czechoslovakia. In addition, the "Intercosmos-21" carries a multi-channel spectrometer developed by scientists of the GDR. The spectrometer will be used to develop methods for locating ocean plankton from space. This will doubtless be of aid in future for locating fish. The satellite also has a radiometer for measuring the intensity of radiothermal radiation of the atmosphere and the surface

of the earth and a magnetometer created by Soviet and Romanian scientists to study the magnetic field of the planet.

V. Balebanov added that plans include participation of research ships and airplanes. This will be of assistance in deciphering the scientific data received from the satellite.

[80-P]

CSO: 1866

DISTORTIONS IN PHOTOGRAPHS TAKEN FROM SPACE BY SCANNER SYSTEMS

Moscow ISSLEDOVAN'YE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 80 pp 97-104
manuscript received 10 Sep 79

YUROV, V. I., Institute of Space Research of the USSR Academy of Sciences, Moscow

[Abstract] The determination of the relationship between the coordinates of image points and the ground surface in scanner images is complicated by the curvature and rotation of earth, terrain relief and ray refraction in the atmosphere, as well as such equipment parameters as the position of the vehicle in orbit, the scanning altitude and the orientation of the image axes relative to the coordinate system adopted as the base. Analytical expressions are adduced for the impact of these factors on the resulting image geometry. The analysis is based on the estimation of the angle of the deviation of the scanning beam from the position coinciding with the final scanning projection. It is recommended that the influence of the earth's curvature be taken into account in designing scanner systems and it is noted that variations in the internal geometry of an image are related to unavoidable errors in the fabrication and assembly of scanners. Calibration data on scanner systems is the only approach to the elimination of this type of error. The relevant formulas are illustrated graphically showing: The shift in the coordinates of image points as a function of the earth's curvature with a change in the orientation angles of the scanning beam; the shift of an image element along a line and a row of an image due to the earth's rotation as a function of the latitude and orbital inclination; the change in the coordinates of an image point as a function of the terrain relief altitude, the orientation angles of the scanning plane and the number of elements in a line of the scanning image. Figures 4; references: 7 Russian. [24-8225]

PRACTICAL ASPECTS OF THE RADIATION CORRECTION FOR MULTIBAND VIDEO INFORMATION

Moscow *ISSLEDOVANIYE ZEMLI IZ KOSMOSA* (in Russian No 4, Jul-Aug 80 pp 59-68
manuscript received 2 Oct 79

ASHUB, V. V., SPIRIDONOV, Yu. G. and TISHCHENKO, A. P., State Scientific Research Center for the Study of Natural Resources, Moscow

[Abstract] In designing an adaptive system to effect the radiation compensation of multiband images of the earth from space, it is possible to minimize the amount of teaching data required by ascertaining the functional relationships between this teaching data and the information being sought. This paper derives practical algorithms for the solution of adaptation and correction problems which are efficient in real situations of computer analysis and which require a minimum of additional data such as information on the atmosphere transmittance, ground surface radiation intensity measurements, etc. A statistical approach to the adaptation problem is proposed which permits the use of asynchronous teaching data for image correction. A common feature of all the algorithms is the assumption of a linear relationship between the registered results and the reflective properties of the earth's surface. The statistical analysis of multiband adaptation is predicted on the application of a maximum likelihood function, the method of least squares and a nonlinear programming algorithm of Davidson, Fletcher and Powell. The proposed technique was tested with a four-band scanner image obtained from the Meteor satellite. Two images of the same area (the Rybinsk water reservoir) were taken a month apart. The efficiency of the statistical radiation correction was checked as follows: the data from the first photo were used as teaching data in the identification of water surfaces in the second. The interpretation was repeated after this, but following the adaptation of the data using the maximum likelihood technique. Finally, the teaching data and identification were based solely on the second photograph. This strategy simulates the interpretative approach based on a bank of signatures, when the bank employs teaching statistics and is adapted to specific conditions. A figure illustrating the radiation correction for this water basin shows that the results of interpretation based on statistics from the bank after radiation correction are actually indistinguishable from the results based on the statistics of the photograph itself. It is shown that this statistical technique used in conjunction with methods based on physical models makes it possible to extrapolate information from the data bank, and thereby substantially reduce the requirements placed on the synchronous a priori data gathered from nonsatellite sources. The impact of the units in which an image is represented on the optimal form for the representation of video information is also treated from the standpoint of the response of the human eye. An example of optimal representation of a radiation corrected image of the Selenga river delta is shown. Figures 2; references: 6 Russian.

[24-8225]

THE OPTICAL SPATIAL-FREQUENCY RESPONSE OF THE ATMOSPHERE AND ITS APPLICATIONS

Moscow IZSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 80 pp 69-80
manuscript received 28 Nov 79

MISHIN, I. V. and SUBHKEVICH, T. A., State Scientific Research Center for the Study of Natural Resources, Moscow; Institute of Applied Mathematics imen' M.V. Keldysh, Moscow

[Abstract] The problem of accurately describing the amplitude and phase distortions of an image of the earth's surface which are due to scattered radiation in the atmosphere is crucial to the study of natural resources. Previous literature has approached the problem of finding the functions governing the atmospheric transformation of the spatial distributions of the brightness of a light field propagating from the ground into space through the formulation of a boundary problem with an integro-differential equation describing the optical transfer function, i.e., the spatial-frequency characteristic of a linearized system of radiative transfer in a planetary atmosphere. The spatial-frequency characteristic (SFC) is invariant with respect to inhomogeneities in the albedo of the subjacent surface, and thus the introduction of a boundary problem for the SFC substantially simplifies the technique of studying spatial distributions of atmospheric brightness. This paper solves the boundary problem for the SFC of the atmosphere using an iteration technique with integration along the transport equation characteristics and employing quadratures on a unit sphere. Some of the functions governing the transfer of spatial distributions of light field brightness in the atmosphere are studied using the proposed SFC technique; these functions are illustrated with examples solving direct problems of atmospheric optics which arise in remote studies of the spatial structure of the earth's brightness field, and in the mathematical modeling of real images. The application of the SFC technique to the solution of the inverse problem (the restoration of the subject of a photograph) is also treated. The detailed mathematical analysis generates equations for the amplitude-frequency characteristic of scattered radiation in the atmosphere as a function of distance from the surface. The brightness profiles of objects on the earth's surface and observed through the atmosphere are calculated; two cases considered are: 1. A subjacent surface containing natural objects with bright, pronounced periodic structures; the albedo is specified in this case by a truncated Fourier series; 2. A subjacent surface with inhomogeneities of unlimited extent, corresponding to extremely extensive geographical objects. In both cases, the solution of the problem of constructing an optical image of a surface distorted by horizontally inhomogeneous streams of scattered radiation is reduced to an inversion of the SFC. The boundary problem which satisfies the SFC is solved using the iteration procedure for solution of boundary problems of a one-dimensional transport theory developed by the Institute of Applied Mathematics of the USSR Academy of Sciences. The method is precise and can be used to check the accuracy of other techniques. This paper is a theoretical treatment devoid of numerical or experimental examples; the expressions are directed primarily towards the design of the mathematical tools needed for the interpretation of data from optical band studies using satellites and subsatellites, and are to be used in estimating the impact of the atmosphere on the experimental data. Figures 5; references: 27 Russian.

[24-8225]

THE COMPILATION OF STRUCTURAL GEOLOGICAL MAPS OF THE KOLA PENINSULA BASED ON PHOTOGRAPHS TAKEN FROM SPACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 80 pp 18-24
manuscript received 23 Jan 80

UVAD'YEV, L. I., MATVEYEVA, O. V. and PEREVOZCHIKOVA, V. A., "Sovsputgeologiya"
Geological Production Association, Leningrad

[Abstract] Maps showing the geological structures of the Kola Peninsula were compiled from 1:1,000,000 photographs taken from an altitude of 200 to 400 km. Black and white pictures, as well as superimposed images obtained in three different color bands of the visible spectrum were used: yellow, red and blue images. The technique for the interpretation and analytical processing of the space photos involves five basic stages: 1. Visual and photo-optical interpretation to compile charts of the lineaments, which are the basis for the analytical work. All linear, ring and partial ring structures are ascertained in this step. 2. The analytical processing, which involves: a) Plotting the isolines of lineament density by means of photometric averaging of the lineament charts; the density isolines are constructed in three variants with averaging radii of 25, 15 and 5 km. b) Plotting local sectional rose diagrams for the orientation of the lineaments based on optical spatial spectral imaging and photometry. Two orthogonal and two diagonal orientation systems for lineaments having an average angular range of 30° are clearly seen in the rose diagrams. c) The compilation of lineament maps for a selected orientation using a spatial optical filtering technique. d) The drawing of the charts of the lineament grid junctions by means of optically combining the charts of selected strikes of linear elements. 3. The construction of the block structural schematic by means of analyzing the lineament density charts for linear structures with averaging radii of 25, 15 and 5 km. 4. The compilation of fault maps based on the interpreted and analyzed photographs, and 5. The geological interpretation of the revealed faults. Maps illustrating all of the analysis and interpretation steps are depicted as well as the final geological map of the Kola Peninsula, indicating such features as: conglomerates, gravelites, sandstones, aleurites, metneffusive rock, tuff, tuffites, and phyllites of the lower Proterozoic, amphibolites, garnet-biotite gneisses and granulites of the Archean era and lower Proterozoic, etc. Figures 5; references: 7 Russian.

[24-8225]

AN ANALYSIS OF THE RESULTS OF THE INTERPRETATION OF AERIAL AND SPACE PHOTOGRAPHS OF WESTERN UZBEKISTAN

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 80 pp 30-34
manuscript received 26 Dec 79

TKHAY, M. N., Institute of Geology and Geophysics of the Uzbek SSR Academy of Sciences, Tashkent

[Abstract] Western Uzbekistan is used as a test area for a comparative evaluation of the accuracy of the interpretation of aerial and space photographs in defining geological structures. By comparing data from the literature for ring structures and lineaments, the following categories are defined: The most reliably interpreted structures, on which there is 90% agreement among the various authors with respect to areas and dimensions; reliable structures, which show 70 to 80% agreement in terms of areas and dimensions; probable structures, for which there is less than 70% agreement in the various sources or are found by only one of the authors. The rings and lineaments falling in each of these categories are then summarized in tabular form with the specific bibliographic citations. A schematic map indicating the reliability of the ring and linear structures found in Western Uzbekistan is also drawn. Figures 1; references: 5 Russian.

[24-8225]

EXPERIENCE WITH THE COMPILATION OF GEOLOGICAL MAPS BASED ON THE INTERPRETATION OF TELEVISION IMAGES FROM 'METEOR' SATELLITES (USING THE EXAMPLE OF CENTRAL ASIA)

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 80 pp 25-29
manuscript received 26 Dec 79

KIRILLOV, A. B. and BORISOV, O. M., Institute of Geology and Geophysics imeni Kh. M. Abdullayev of the Uzbek SSR Academy of Sciences, Tashkent

[Abstract] Television pictures from "Meteor" satellites with a scale of 1:8,000,000 taken at wavelengths of 0.6 to 0.7 and 0.7 to 0.8 micrometers were used to draw a small scale map of the Central Asian area around the Aral Sea. Some 14 independent geological deposits were identified in the map: contemporary, upper Quaternary, middle upper Quaternary, Neogene, Paleogene-Quaternary, Paleogene-Neogene, Cretaceous Paleogene-Quaternary, Cretaceous Paleogene-Neogene, Cretaceous Paleozoic, Proterozoic and Mesozoic deposits. The photo-interpretive features of these structures and fault lines are discussed; the discussion is illustrated with two maps: one showing the deposits themselves and another schematically showing the fault lines of Central Asia and adjacent territories. The maps were compared with the corresponding geological maps of the same scale and by counting the number of lines per cm^2 of map, it was determined that the load of geological boundaries per unit

area in the maps based on space materials is one-fourth that of the standard geological map, while the number of faults found was 2.5 times greater. Figures 2; references: 6 Russian.
[24-8225]

UDC 551.24:629.78

NEW DATA ON THE GEOLOGICAL STRUCTURE OF THE VERKHOYANSK-KOLYMA FOLD BELT BASED ON THE ANALYSIS OF TELEVISION IMAGES FROM SPACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 80 pp 5-12
manuscript received 6 Mar 80

YANSHIN, A. L., KHVOROSTOVA, Z. M. and ZABELIN, V. A., Institute of Geology and Geophysics of the Siberian Department of the USSR Academy of Sciences, Novosibirsk; Computer Center of the Siberian Department of the USSR Academy of Sciences, Novosibirsk

[Abstract] Television and scanner pictures taken from space of the region east of Yakutsk between 1974 and 1979 by the Meteor satellites and the American ESSA and NOAA satellites (with scales of from 1:7,000,000 to 1:15,000,000) were analyzed to ascertain two new geological structures of regional rank. The structures were found on 124 photographs taken at various times of the year by different satellites; both structures fall in bounds of the Verkhoyansk-Kolyma mesozoic fold. One of them encompasses a considerable portion of the Yana river basin, reaching about 300 km in cross-section while the other takes up the upper portion of the Indigirka river basin and is about 275 x 350 km. These two photographic anomalies (the Nel'gese-Bytantay and the Nera-Indigirka) were detected both in visible and infrared photos. The interpretation and correlation of deep structures with surface points were accomplished by transferring the infrared and visible spectrum images to BESM-6 computer disks and then visualizing coordinate points on the photos using the MARK-2 scanner of the P-1700 system. After the coordinates of the control points of the visible band photographs were found, they were correlated with the infrared machine coordinates of the photos and the relationship between the two sets of coordinates was established, making it possible to easily shift from the coordinates of one photo to another. The location of the photographic anomalies of visible band photographs were then mapped on the infrared images. The resulting interpretative map of the pair of anomalies shows the surface contours for the Verkhoyansk complex of geosynclinal sedimentary deposits, including: Jurassic, Triassic, Permian deposits, granitoid batholite type intrusions and subvolcanic dacites, faults at the northwest terminus of the Ayan-Uryaksk anticlinorium, etc. The lack of a correlation between TV images and landscape features on the surface indicates that space material contains additional data on the structure of the earth's core. Difficulties in the interpretation of such core features are discussed and it is argued that the high degree of generalization of small scale TV images is the factor accounting for the manifestation in such images of that portion of the surface radiation which is the response of ground materials to solar illumination. If it is allowed that this reaction depends to some extent on the physical and chemical characteristics as well as the structural and textural features of the rock (which in turn are determined by the entire geological developmental history), it can be anticipated that

the various structures deep in the earth's core can be reflected in the intensity of the ground radiation, and consequently, lead to a change in the photographic tone of photos taken from space. Though this paper is not conclusive, it is noted that a confirmation of this hypothesis would open up new prospects for the interpretation of core features at greater depths. Figures 1, references: 17 Russian.

[24-8225]

SPACE POLICY AND ADMINISTRATION

ACHIEVEMENTS AND PROSPECTS OF 'INTERSPUTNIK'

Moscow IZVESTIYA in Russian 9 Jan 81 p 2

[Article by L. Chausov]

[Summary] The "Intersputnik" organization will mark its 10th anniversary in 1981. According to Yu. I. Krupin, general-director of "Intersputnik", intercontinental space communication began in 1973 when the "Caribe" ground station began operating at Jaruco near Havana. At present there are ground stations not only in the USSR and Cuba, but also in Bulgaria, Hungary, Vietnam, the GDR, Mongolia, Poland and Czechoslovakia. The technical base of the system is always being improved. "Molniya" satellites in elliptical orbits are replaced by stationary "Gorizont" satellites. There are now 4 to 8 hours of satellite transmissions every day and the volume can be increased when necessary. For example, during the 1980 Olympics there were 460 transmissions lasting a total of 820 hours. At the 9th session of the "Intersputnik" Council in Havana in November 1980, plans for further development of the system were adopted. New satellite launches are planned and ground stations will be improved.

[50-P]

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'LE MONDE' ON FRENCH ROLE IN REVISED VENUS-HALLEY'S COMET MISSION

Paris LE MONDE in French 12 Feb 81 p 4

[Article by J.-F. Augereau]

[Text] French scientists will not see their balloons floating through the atmosphere of Venus to analyze its components. This French-Soviet mission, known as Venera-84, has undergone such changes in recent months that it is impossible for the French to implement a more modest balloon program compatible with new Soviet limitations. Soviet space program officials, in agreement with their French partners, have therefore recently decided to reorganize the Venera-84 mission, which will now be called the Venus-Halley's Comet mission. It consists of launching two Soviet space vehicles, each composed of two units in which French research equipment will be installed: a descent module for Venus and an observation probe for Halley's Comet.

The presence of Halley's Comet in the sky in 1910 aroused the enthusiasm of astronomers and astonished crowds. Sixty-one years later on the eve of its next journey through the earth's belt, expected in 1986, several countries are preparing for this new rendezvous. The unequalled observation possibilities offered by space technology have in fact led Japan, Europe, the Soviet Union and the United States to establish comet mission programs. For the time being, Europe with the Giotto program and the USSR with the Venus-Halley's Comet mission, with which the French are closely associated, are the only ones firmly committed to carrying out such missions. Japanese intentions are not very well known as yet. Although the first to enter the race, the Americans are experiencing some problems for lack of ad hoc financing.

The priority granted by the Soviets to the rendezvous with Halley's Comet indirectly led to scuttling the Venera-84 program, a keystone of French-Soviet space cooperation in the scientific area. That particularly unique mission was to result in the launching of large-diameter balloons carrying research equipment for analyzing the atmosphere of Venus. Some of the carrier vehicles used were to be put into orbit around the planet to supplement the study. For various reasons, simultaneously of a technical (weight estimates), financial (use of four rockets instead of the two planned) and finally scientific nature (passage of Halley's Comet in 1986), the Soviets were forced to redefine their program and therefore asked the French to consider a modified mission: small balloons passing through the atmosphere of Venus at an altitude of 40-48 km (LE MONDE of 1 November 1980).

Despite the efforts made, the new balloon models could not be delivered to the Soviets in time to be installed in the vehicles. Thus steps were taken in Moscow in early February toward a new mission: Venus-Halley's Comet. In the opinion of Mr Hubert Curien, director of the National Space Studies Center (CNES), "we mustn't have any regrets, for this new program is both very complete and very attractive."* In fact, it enables the French scientific community to make a descent on Venus and to participate in studying Halley's Comet at very little expense (Fr 70 million over 3 years). By way of comparison, the amount spent by the French on the European Giotto experiment is slightly more than about Fr 100 million (LE MONDE of 12 July 1980).

Two 4-Ton Space Vehicles

In its present form, the Venus-Halley's Comet program is supposed to result in the launching of two Soviet space vehicles weighing approximately 4 tons in December 1984. These two spacecraft will be aimed at Venus, which they will reach sometime during June 1985. At that time, they will each split into two units.

The first unit, composed of an approximately 1-ton descent module, is scheduled to make a soft landing on Venus and to operate there for 1 hour before being destroyed by atmospheric heat. It will carry between 60 and 80 kg of instruments and of the eight research instruments with which it will be equipped, six have been built in cooperation with the French.

The second part of the vehicle is a comet probe weighing approximately 2 tons, in which about 10 research instruments will be installed. Three of them--an infrared spectrometer, closeup television camera and three-channel spectrometer--are mainly French-made, whereas several others have been built in cooperation with certain Eastern countries (Poland, the GDR and especially Hungary). There is a total of 114 kg of research equipment, although with a small operating margin for two additional research instruments which the French could suggest if the Soviets agree to the extra weight.

Regarding this mission as a whole, French scientists will have access to all data collected by the Soviet control center and will therefore be among the first to interpret the information obtained in March 1986 by the two Soviet comet probes, which will come within 3,000 to 10,000 meters of Halley's Comet: one 4 days before the European Giotto probe and the other 1 day afterwards.

*The CNES will keep a definite watch on the balloons and there will be a meeting with the Soviets between now and the end of the year to discuss new Venus programs. [4-11915]

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COMMENTS ON FUTURE OF SOVIET SPACE PROGRAM

Moscow EKONOMICHESKAYA GAZETA in Russian No 4, Jan 81 p 24

[Excerpt from article by B. Fedorov]

[Excerpt] The plan for the economic and social development of the USSR in the Eleventh Five-Year Plan provides for the continuation of study and exploitation of space, broadening of investigations on the use of space vehicles in the study of natural resources and meteorology, oceanology, navigation, communications and other needs of the national economy.

Glance Into the Future

In the coming decade cosmonautics will support global radio communication and television, navigation of aircraft and ships, the world weather service and preservation of the environment, extensive investigation of nature and the natural resources of our planet. In the distant future these can be specialized long-lived orbital stations and technological complexes of a completely new quality and reliability, considerably exceeding those characteristic of today.

The future is created in the present. Today's orbital stations are a prototype of future settlements of man in space. After evaluating the attainments of Soviet scientists, engineers, workers and cosmonauts from today's points of view, we have the right to think about superlong space flights during the coming decades, although, to be sure, predictions in cosmonautics are extremely risky: the path of space science and technology is so bold and impetuous that the unexpected can always happen.

If we speak in terms of the near future, scientists and designers are working on a new generation of Soviet orbital stations.

It is known that a space station is an expensive object and its effective use in space is dependent primarily on the presence of a crew on board the station. With respect to effectiveness the "Salyut-6" considerably surpasses its predecessors. During the more than 1,200 days of orbital station flight a good half was accounted for by its intensive operation in a manned regime. The expenditures will be relatively small and the effect will be extremely significant if the replacement of the crews occurs directly aboard the flying laboratory. In other words, there will always be a crew aboard.

The "Progress" freighter won great renown in the implementation of the flight program of the major space complex. It was precisely this space freighter which made possible such prolonged functioning of the "Salyut-6," regularly supplying fuel and other expendable materials.

What will be the next steps into space? Specialists are unanimous in the opinion that one of the most probable ways to create large objects in orbit will be the modular construction principle. The orbital station will consist of different modules, each of which will be equipped for carrying out specific tasks: implementation of scientific investigations, for the resting of cosmonauts, for carrying out technological experiments, for the return of cosmonauts to the earth, etc.

Multi-ton elements will be put into orbit and there will be assembled into monolithic structures. In such a way it will be possible to create in circumterrestrial space major scientific and orbital complexes having four-six docking units.

When the orbital station consists of several functional modules it will be able to exist for decades. This is a problem of the future, but the "Salyut-6" indicated the way to solution of such a problem.

In the more distant future scientists foresee the creation of far larger stations which will be of great importance for all the inhabitants of our planet, and will make possible the appearance of constructions for the transmission of electric power to the earth from space. From these stations manned ships will be launched into the depths of space, where, in turn, the construction of extraterrestrial settlements will begin.

[63-5303]

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THE ACTIVITY OF THE UNITED STATES WITHIN THE FRAMEWORK OF THE PROGRAM FOR THE STUDY OF NATURAL RESOURCES FROM SPACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 80 pp 113-120
manuscript received 21 Apr 80

VASIL'YEV, A. A.

[Abstract] A brief introductory discussion of the history and functions of the Landsat satellites is followed by an outline of the primary tasks of the NASA earth resources survey program and a detailed treatment of the equipment on board the Landsat series, including: the return beam vidicon, the multispectral scanner, the thematic mapper, the two-channel infrared radiometer on the HCMH satellite as well as the few specifications known for the Stereosat satellite. The precision and coverage of the Landsats are discussed along with the ground support stations. The review of the programs carried out by the Landsats covers: geology, agriculture, land use, oceanography and water resources. The economic and organizational aspects of the NASA earth resources satellite programs are summarized and the article concludes with a negative review of the impact of the U.S. Congress, business groups and the president and his administration on the satellite programs as well as a commentary on the poor cooperation of the U.S. with the USSR and other nations. References: 16 Western.

[24-8225]

LAUNCH TABLE

LIST OF RECENT SOVIET SPACE LAUNCHES

Moscow TASS in English or Russian various dates

[Summary]

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
20 Jan 81	Cosmos-1240	377 km	178 km	89.8 min	64.9
21 Jan 81	Cosmos-1241	1,000 km (circular orbit)	--	1 hr 45 min	65.8
24 Jan 81	Progress-12	299 km	188 km	89.1 min	51.6
	(Docked with "Salyut-6" on 26 Jan; refueled "Salyut-6" and delivered other supplies. "Progress-12" engine burn on 28 Jan corrected "Salyut-6" orbit to 359/307 km, 90.9 min, 51.64 degrees)				
27 Jan 81	Cosmos-1242	684 km	635 km	97.6 min	81.2
30 Jan 81	Molniya-1	40,801 km	464 km	12 hr 16 min	62.8
	(Communications satellite for long-distance telephone and telegraph communications and TV broadcasting in the "Orbita" network)				
2 Feb 81	Cosmos-1243	1,026 km	316 km	98 min	66
	(Launch announcement indicates that the flight program was completed)				
6 Feb 81	Intercosmos-21	520 km	475 km	94.5 min	74
	(To test methods for ocean and earth surface studies and systems for automatic data collection from sea and ground stations; carries equipment designed by Hungary, GDR, Romania, USSR and Czechoslovakia)				

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
12 Feb 81	Cosmos-1244	1,024 km	975 km	105 min	82.9
13 Feb 81	Cosmos-1245	403 km	208 km	90.3 min	72.9
18 Feb 81	Cosmos-1246	292 km	202 km	89.2 min	64.9
19 Feb 81	Cosmos-1247	39,540 km	613 km	11 hrs 49 min	62.8
5 Mar 81	Cosmos-1248	371 km	180 km	89.7 min	67.1
5 Mar 81	Cosmos-1249	282 km	258 km	89.6 min	65
6 Mar 81	Cosmos-1250-- Cosmos-1257	1,500 km	1,450 km	115 min	74
		(Eight satellites launched by a single booster)			
14 Mar 81	Cosmos-1258	1,032 km	322 km	98 min	65.8
		(Launch announcement indicates that the flight program was completed)			

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